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Using Games for Training Dismounted Light Infantry Leaders: Emergent Questions and Lessons Learned

Scott A. Beal
U.S. Army Research Institute

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U.S. Army Research Institute
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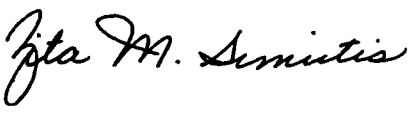

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14. ABSTRACT *(Maximum 250 words)*: The U.S. Army Infantry School has explored the use of PC- and console-based games for training Infantry leaders. There has been a need to examine the effectiveness of training games and to capture lessons that could help shape the development and use of future games. This report presents emergent questions and lessons learned from evaluations of three games designed to train dismounted light Infantry leaders: Full Spectrum Command, The Rapid Decision Trainer, and Full Spectrum Warrior. Results from the evaluations showed that the most effective training experiences occurred when a game was developed to address specific training objectives and needs. Infantry leaders reported to value training to a greater extent when qualified instructors were present to offer feedback during mission execution and detailed after action reviews following training exercises, as opposed to using the game as a stand-alone trainer. Leaders reported that the use of sophisticated graphics did not impact perceived training value, and that training with games for fun and personal entertainment was less important than learning and practicing leader tasks and skills. Leaders also suggested that the ability to modify games over time was necessary to maintain training relevancy.

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and Training Technology

Using Games for Training Dismounted Light Infantry Leaders: Emergent Questions and Lessons Learned

Executive Summary

Research Requirement:

The Department of Defense (DoD) has endorsed the use of live, virtual, and constructive simulations in their efforts to meet new training demands and implement more efficient training methods. In response to DoD training initiatives, the U.S. Army Infantry School at Fort Benning, Georgia, has explored the use of desktop virtual simulations with game-based technologies. While these types of innovative tools have potential for augmenting the training of Infantry leaders, there has been a need to evaluate the extent to which training games meet training objectives and prepare leaders for current and future combat environments. There has also been a need to guide and optimize the efforts of training game developers to supply the Infantry School with effective and efficient training tools that will promote performance to standard.

The Program Executive Office for Simulation, Training, and Instrumentation (PEO-STRI) and the U.S. Army Research, Development and Engineering Command Simulation and Training Technology Center (RDECOM-STTC) asked the Infantry Forces Research Unit (IFRU) of the U.S. Army Research Institute at Fort Benning, Georgia, to assist with the evaluation of training games that were developed specifically for dismounted light Infantry leaders. This report describes some of the emergent questions and lessons learned from evaluations of three training games: Full Spectrum Command (FSC), the Rapid Decision Trainer (RDT), and Full Spectrum Warrior (FSW).

Procedure:

In the first evaluation, 54 captains in the Infantry Captains Career Course (ICCC) used FSC, a PC-based training game intended to improve their ability to adapt to changing conditions and emerging threats. In a following series of evaluations, 195 lieutenants enrolled in the Infantry Officer Basic Course (IOBC) used the PC-based Rapid Decision Trainer to rehearse squad- and platoon-level live-fire exercises, initiate critical tasks, and make decisions essential to successful mission execution. In the final evaluation, 140 students in the Basic Non-Commissioned Officer Course (BNCOC) and 90 students the Primary Leadership Development Course (PLDC) used FSW, a console-based training game, to practice squad tactics and decision-making in simulated urban operations.

The emergent questions and lessons learned included in this report were gleaned from the following sources: training game evaluation results, interviews with military training game producers, developers, and leaders and instructors at the Infantry School who served as subject-matter experts (SMEs) during game development, formal

and informal discussions with instructors and leaders who participated in our evaluations, and observations of Infantry leaders as they trained with games.

Findings:

Results from the evaluations showed that the most effective training experiences occurred when a game was developed to address specific training objectives and needs. Infantry leaders reported to value training to a greater extent when qualified instructors were present to offer feedback during mission execution and detailed after action reviews following training exercises, as opposed to using the game as a stand-alone trainer. Leaders reported that the use of sophisticated graphics did not impact perceived training value, and that training with games for fun and personal entertainment was less important than learning and practicing leader tasks and skills. Leaders also suggested that the ability to modify games over time was necessary to maintain training relevancy.

Utilization and Dissemination of Findings:

Findings from these evaluations were used to guide the implementation of training game exercises for Infantry leaders. The results were briefed to senior personnel in the U.S. Army Infantry School and the U.S. Army Research, Development and Engineering Command, Simulation and Training Technology Center (RDECOM-STTC).

USING GAMES FOR TRAINING DISMOUNTED LIGHT INFANTRY LEADERS: EMERGENT QUESTIONS AND LESSONS LEARNED

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Introduction

On June 9th, 2004, the Department of Defense (DoD) published an updated Training Transformation Implementation Plan that stated, "Training must now prepare the force to learn, improvise, and adapt to constantly changing threats in addition to executing doctrine to standards" (DoD, 2004). In their efforts to meet these new training demands and implement more efficient training methods, the DoD reiterated an endorsement for using live, virtual, and constructive simulations for mission rehearsal and leader training.

In response to DoD training initiatives and their own training needs and objectives, the U.S. Army Infantry School at Fort Benning, Georgia, has made efforts to exploit the use of desk-top virtual simulations that include commercial game technologies. These "training games," as they are called, are assumed to enhance the realism of simulation training, provide Infantry leaders with low-cost, repetitive opportunities to confront and adapt to emerging threats, allow leaders to apply leader skills and perform tasks to standard, and contribute to overall training effectiveness.

There has been a need to evaluate the extent to which training games meet DoD and Infantry School objectives and provide leaders with the experiences they need to prepare for the demands of current operating environments. There has also been a need to guide training game developers in their efforts to supply Infantry leaders with effective tools that will augment existing training experiences and promote performance to standard. Researchers at the Infantry Forces Research Unit of the U.S. Army Research Institute were given opportunities to conduct several evaluations of training games as they were used by the Infantry School.

The purpose of this report is to describe some of the lessons learned directly from our participation in evaluating three games developed for training Infantry leaders. We also offer considerations for future development and use of military training games in general. The information used to produce this report was gleaned from the following sources: (a) results from our training games evaluations, (b) interviews with military training games producers, developers, and Army leaders from the Infantry School who served as subject matter experts during training games development, (c) formal and informal discussions with leaders who participated in our evaluations, and (d) observations of leaders as they trained with games during our evaluations and during Infantry school courses. Readers should keep in mind that lessons and considerations described in this report are based on training games developed specifically for dismounted light Infantry leaders. Generalization of our considerations to other military training games and Soldier populations should be made with caution.

Three Training Games

The Infantry Forces Research Unit (IFRU) of the U.S. Army Research Institute at Fort Benning, Georgia, was asked by the Program Executive Office for Simulation, Training, and Instrumentation (PEO-STRI) and the US Army Research, Development and Engineering Command Simulation and Training Technology Center (RDECOM-STTC) to assist with the evaluation of three training games that were developed specifically for Infantry leaders. Researchers from the IFRU worked with leaders from the Infantry School at Fort Benning to assess three games: Full Spectrum Command, The Rapid Decision Trainer, and Full Spectrum Warrior. These three games were developed for dismounted Infantry company commanders, platoon leaders, and squad leaders respectively.

Full Spectrum Command (FSC). FSC is a computer-based training game for prospective company commanders that presents a simulated urban environment in which a captain commands a light Infantry company engaged in offensive operations. The simulated terrain in FSC represents a 1-kilometer square area modeled after the McKenna Military Operations in Urban Terrain (MOUT) Site at Fort Benning, Georgia.

Computer-generated friendly forces in the FSC game are those typically available to a light Infantry company commander, while the opposing forces represent the type of threat that a company commander might face during urban operations. The objectives of the game were to let leaders who attended the Infantry Captains Career Course conduct mission analysis and planning, experience simulated mission execution and related decision-making requirements, and improve their ability to adapt to emerging conditions on the simulated battle field (see Beal & Christ, 2004, for a more complete description of FSC).

FSC Evaluation. Fifty-four leaders in the Infantry Captains Career Course participated in our training effectiveness evaluation of FSC. Half of the leaders were assigned to train with FSC in addition to participating in their normal course work for commanding a light Infantry company in urban offensive operations. The other half did only the normal course work.

Leaders provided information about their military experience and were tested for general cognitive ability and decision-making style prior to training with FSC. Following course work and FSC training exercises, leaders completed a Soldier Perception Questionnaire that documented their sense of personal involvement in the FSC environment, their perception of the training value of the game, and their opinions about its strengths and weaknesses as a training tool. Leaders in both groups were then assessed for their decision-making proficiency and their ability to adapt to emerging conditions as they commanded a light Infantry company during a tactical exercise using the Janus simulation (see Appendix A for a description of Janus).

The Rapid Decision Trainer (RDT). Leaders and instructors in the Infantry Officer Basic Course (IOBC) at Fort Benning, Georgia, recognized the potential of using game technology to train lieutenants to serve as platoon leaders. During the IOBC, lieutenants experience squad- and platoon-level field and live-fire exercises (LFXs) that help them to become familiar with the decisions that squad and platoon leaders must make to complete successful attack missions. However, due to time and other resource constraints, only a few lieutenants have the opportunity to serve as squad and platoon leaders during LFXs and other field exercises.

The RDT was developed as a computer-based training game to allow all lieutenants attending the IOBC the opportunity to serve as squad and platoon leaders during simulated attack missions, and prepare them for the decisions they would need to make to complete a successful LFX. To aid instructors' efforts to assess the lieutenants' RDT performance, the game automatically tracks the critical tasks that lieutenants initiate during their missions, and then provides instructors with results of lieutenants' task performance during an assessment phase at the conclusion of each mission (see Beal & Christ, 2005, for a more complete description of the RDT).

RDT Evaluation. We conducted three evaluations of the RDT with the IOBC: an alpha version for platoon leader, an updated platoon leader version, and a squad leader version. During the evaluation of the alpha version for platoon leader, 19 lieutenants were assigned to train with the RDT in one large group and 20 other lieutenants trained in two-man buddy-teams. Following the RDT missions, lieutenants in both training conditions participated in an after action review with an instructor.

A Soldier Perception Questionnaire administered to the lieutenants documented their perceptions and opinions of RDT training value, their motivations for training with the RDT, their sense of personal involvement in the simulated mission, and the adequacy of the realism portrayed in the simulation. Upon completion of the questionnaire, lieutenants participated in discussions focused on the RDT's training usefulness and effectiveness. Following the RDT training, the lieutenants participated in a LFX. A second Soldier Perception Questionnaire with similar items was administered following the LFX.

Seventy-six lieutenants participated in the evaluation of the updated platoon leader version of the RDT, and 80 participated in the evaluation of the squad leader version. During both evaluations lieutenants trained with the RDT in buddy teams, participated in after action reviews with instructors, completed Soldier Perception Questionnaires, and engaged in discussions. Following the RDT training, lieutenants participated in a LFX, and then completed a second Soldier Perception Questionnaire.

Full Spectrum Warrior (FSW). The FSW game resulted from the Army's attempt to determine if high fidelity computer graphics and other commercial game technologies could be utilized to improve the realism and effectiveness of virtual simulations used for Army training. FSW is a tactical decision and action game built for Microsoft's X-box console that simulates Infantry squad-level operations in urban and

suburban environments. It is not a first-person shooter game, but it does have more commercial game qualities than FSC and the RDT.

Two versions of FSW were developed: an Army version to be used by leaders who were practicing squad-level battle drills, and a commercial version to be sold to the public. In both versions the player acts as an Infantry squad leader who directs and controls the actions of two four-man fire teams. Leaders focus on movement through complex simulated terrains, fire distribution and control, reaction to enemy contact, and room clearing exercises. Researchers at the IFRU assisted with the evaluation of the Army version of FSW (see Centric, Beal & Christ, 2004).

FSW Evaluation. One-hundred forty sergeants from the Basic Non-Commissioned Officer Course (BNCOC) and 90 sergeants from the Primary Leader Development Course (PLDC) participated in our evaluation of the Army version of FSW built for Microsoft's X-Box system. Each sergeant completed two FSW scenario mission executions at an individual work station. Following FSW mission execution, sergeants completed Soldier Perception Questionnaires and engaged in discussions about the training effectiveness of FSW.

We engaged in discussions about the training potential and effectiveness of FSW with senior instructors from the Advanced Non-Commissioned Officer Course (ANCOC), the Infantry Captains Career Course (ICCC), and with leaders and instructors from the Combined Arms and Tactics Directorate (CATD) at Fort Benning. Table 1 shows a summary of training game evaluations that contributed to this report.

Table 1
Summary of Training Games Evaluations

Training Game	**Infantry School Course**	**Number of Participating Soldiers**
FSC	ICCC	54
RDT (alpha version for platoon leader)	IOBC	39
RDT (updated platoon leader version	IOBC	76
RDT (squad leader version)	IOBC	80
FSW	BNCOC, PLDC	140 (BNCOC), 90 (PLDC)

Emergent Questions and Lessons Learned

The lessons described in this report were presented in rank order, starting with what we believe are most important in terms of their efficacy to impact overall military training games development and effective use for training Infantry leaders. We distinguished whether the information relative to each lesson we presented was from one or more of the following sources: (a) results from our training games evaluations, (b) interviews with military training games producers, developers, and Army leaders and instructors from the Infantry school who served as SMEs and guided development, (c) formal and informal discussions with leaders who participated in our evaluations, and (d) observations of leaders as they trained with games developed for dismounted Infantry.

We began each section with a question that emerged during our games evaluations and was specific to the use of training games, and then followed with the lessons we learned relevant to the question. The following questions were presented:

- ***Should training games be used as "stand-alone" trainers?***
- ***How important to training game effectiveness is a clearly defined training objective?***
- ***Do training games need sophisticated computer graphics to be effective?***
- ***Do training games have to be fun?***
- ***How can training games maintain relevancy over time?***
- ***Are training games more efficient than other existing methods of training?***

Should training games be used as "stand-alone" trainers?

The proposition that leaders can engage in effective training by playing a training game in a day room or at home on their personal computers is an attractive idea to those who understand the time constraints currently imposed on programs of instruction and unit training exercises. That games can be used as effective stand-alone trainers is based on the following assumptions: (a) leaders will train with games on their own time because they already spend time playing commercial games, (b) the guidance of a qualified instructor is not always necessary in order for effective training to occur, and (c) leaders are capable of assessing their own training game performance to standard.

Lesson #1: Leaders differ in their proficiency with games and personal computers. We found that leaders' experience and proficiency with games and computers varied widely. Results from our research showed that more than 70% of the participants in our evaluation of the computer-based FSC game reported that they had to focus on computer control devices and functions rather than on the experiences created by the simulation. Similar results emerged during the FSW and RDT evaluations when leaders rated the ease with which they were able to learn to control Microsoft's X-Box console and personal computer functions for the two games respectively. If these results are representative of the larger leader population, then

they suggest that the majority of leaders who train with games need sufficient time to practice functions and capabilities, and time to learn the systems upon which the games are built.

During our evaluations, we tended to overestimate leaders' proficiency with game consoles and personal computers and underestimate the time required for an effective training experience. Creating effective training opportunities usually required more time than we anticipated for leaders to become familiar with training game console and computer functions and capabilities enough to allow them to focus on applying leader tasks and skills.

Lesson #2: The participation and guidance of qualified instructors is essential to effective training with games. Leaders are certainly capable of learning on their own. However, we do not know the extent to which using games as stand-alone trainers help leaders perform to standard. Based on our observations during all our evaluations, leaders seemed to reap the most benefits from training games when their instructors gave them clear and complete instructions about the purposes for which they were using a game, when instructors demonstrated necessary game functions and limitations, when tactical and functional shortfalls of a game's software were explained, when instructors gave examples of an effective mission execution, and when instructors briefed the operations orders prior to games training.

We are confident that training with games is more effective when qualified instructors are present to guide leader behavior by offering coaching and feedback, evaluating performance, and conducting after action reviews that require leaders to think critically about their actions and decisions. During each of our training games evaluations, we asked leaders to rate the extent to which a qualified instructor should be present to provide tactical guidance during training games exercises, and the extent to which an instructor should be present to conduct after-action reviews. Leaders' ratings for these two items were overwhelmingly positive, suggesting they believed that the effectiveness of training with games was determined in large measure by the role of qualified instructors.

In a few instances, we observed that when some leaders used games without the guidance of an instructor, they tended to employ tactics during simulated mission execution that resulted in fratricide, the death of civilians, and bringing missions to a premature end. Considering these observations, we believe instructors can help leaders understand the importance of making and applying sound tactical decisions by offering feedback and coaching, which should increase the probability of an overall effective training experience.

Instructors we interviewed at the Infantry School who had experience with training games suggested that leaders may receive some residual benefit from using a training game without the active involvement of a qualified instructor. However, performance assessment mechanisms should still be in place to ensure that the leader performs to standard. On his own, a leader may perform some tasks correctly, while

others he may not, even though the tasks may be performed quickly and efficiently. Therefore, success with training games requires an effective combination of trainer, trainee, and tool.

Lesson #3: Training games that track performance automatically can assist instructors in assessing leader performance. Military leaders and instructors who use games to help train leader tasks and skills are faced with the problem of assessing performance. Training game performance assessments often consist of informal observations made by instructors while leaders execute simulated missions. During these observations, different instructors offer various forms and levels of coaching and feedback based on how well they perceive a leader is performing, and how well they understand the training game. This suggests that standards for training game performance and standards for assessing that performance have yet to be established.

A high degree of variance can exist between leaders in the same training unit because of differences in their computer proficiency and experience with games and game consoles, as stated above. Leaders who do have experience with computers and commercial games may still vary greatly on their levels of military tactical knowledge and proficiency. The challenges of assessing the training game performance of leaders who differ in their proficiency with games and computers and their military tactical knowledge can be minimized by taking advantage of automatic performance tracking capabilities.

Games that are built specifically for the purpose of military training often provide instructors with various types of mission outcome data (e.g., number of friendly force and enemy force kills, rounds expended, frequency of fratricide, weapons use) and mission replay functions. Though limited in scope, these data and functions can provide instructors with meaningful content for use during after action reviews.

To aid instructors in the evaluation process, the RDT was created with the capability to track automatically leaders' initiation of critical tasks required to complete a successful scenario execution. Though rudimentary in form (i.e., indication is given of tasks completed or not completed), this was one objective way of helping instructors assess leaders' performance. In addition, following each mission, leaders were able to view the results of their critical task performance, which served to help them recognize what they did well during the mission and what they could improve upon during subsequent missions. Results from critical task performance assessments also helped instructors determine which content to emphasize during subsequent classroom and field training exercises and after action reviews.

Tracking leaders' critical task performance was an appropriate capability to implement into the RDT because the game was developed to address a very specific training purpose (i.e., mission rehearsal of and decision-making during squad and platoon LFXs) and to present a very specific training scenario. However, automatic performance tracking capabilities would be more difficult to integrate into training games that offer multiple scenarios and broad training experiences because of the increased

tactical complexity that accompanies these characteristics. In addition, the difficulty of including performance tracking in more complex games increases when tracking criteria have to be custom tailored for each scenario.

For the RDT, the use of automatic performance tracking was an effective way to assess how well leaders initiated critical tasks that were relevant to successful completion of a narrowly focused scenario. However, there is a tradeoff. The RDT's training breadth and effectiveness remain somewhat limited by the narrow scope of the training objective for which it was developed to address.

Additional work needs to be done to create automatic performance tracking for games that provide wider training breadth and multiple scenarios with increased complexity. Performance tracking can serve to reduce the impact of differences in leaders' computer competency, game experience, and tactical proficiency when performance appraisals are being conducted. In addition, performance tracking may also serve to lesson the influence of differences in assessment methods and skills between instructors who use games to train leaders.

How important to training game effectiveness is a clearly defined training objective?

Prior to the processes of training game software planning and development, it is important for instructors and developers to define the specific training objective the game is designed to meet. This is determined in large measure by the knowledge, skills and abilities of leaders who will use the game, standards of performance that leaders hope to achieve, the training conditions under which it will be used, and what leaders are expected to gain from the training experience. The definition phase is an important part of any game project because it determines the direction of subsequent planning, developing, implementing, evaluating, and modifying processes.

Lesson #4: Training games development should be driven by predetermined training objectives. According to an experienced military games producer, training games developers may fully intend to create a game that meets specific training needs successfully. However, choices about technology, designers, and creative and presentation styles will be driven by the way the game is defined. A clear and well understood game definition that is determined prior to major resource expenditures can help ensure that the final product will meet the training needs of the leaders for whom it is intended. In order to define a training game's purpose accurately, developers should rely on leaders who can serve as subject matter experts (SME).

Lesson #5: Efforts to develop training games should be guided by qualified military SMEs. To ensure that training games development moves in the direction required for effective training, military SMEs must be intimately involved when a training game project is being defined and developed. The SMEs can provide appropriate answers to the following questions that drive software development: (a) For whom is the

training game being created? (b) At what level or echelon will the game represent? (c) Under what conditions will the training game be used? (d) What specific training objectives will the game address? (e) How can developers ensure that the game will maintain relevancy over time? (f) What is the depth and breadth of training that the game will need to provide? The application of answers to these questions provided by qualified military SMEs will help ensure that a training game meets training objectives and will be accepted and utilized by the leaders for whom it is developed.

According to a senior military training games producer, it is difficult for developers to determine if they made the correct choices about software development until a game is 70% to 80% complete and the first playable versions can be assessed. By the time the first versions are available for evaluation, it is difficult to make sweeping changes to software. This underscores the importance of input from SMEs prior to and throughout the entire games development and testing processes.

Developers who integrate subject matter expertise and build training games on a foundation of solid tactics and training objectives will enjoy success to a greater degree than those who attempt to create games without employing SMEs effectively, or at all. Qualified instructors from the Infantry School who served as SMEs found that their capacity to guide games development and testing in meaningful ways was a function of having time to focus on the task and having authority to request changes to software based on their own military knowledge, experience, and expertise.

Do training games need sophisticated computer graphics to be effective?

One area of training games that has received much attention is the use of sophisticated computer graphics technologies. The presumed effects of implementing the latest graphics include, but are not limited to, heightened realism, increased and sustained suspension of disbelief, more positive leader perceptions of training games experiences, and improved performance. However, to date, we know of no research that has directly addressed and supported these assumptions. It may be that a relatively simple, low-fidelity game can have the same training impact as one with the latest, most expensive graphics built for the same training purpose. In the absence of any systematic empirical investigations, we do not know the extent to which the use of sophisticated graphics enhances performance or overall training effectiveness.

Lesson #6: Sophisticated computer graphics may not be necessary to provide a valuable training experience. We have observed that realistic graphics can make a strong impression on those who view them for the first time. However, game-experienced instructors and leaders tend to focus more on the tasks and skills that can be practiced and reinforced, the game's capabilities and functions, and the accuracy with which tactics and doctrine are represented by the behavior of computer-generated entities. For the purposes of training with games and evaluating their effectiveness and their impact on performance, we believe that developers, researchers, instructors, and leaders should focus less on the presumed benefits of graphics and more on the extent

to which training games allow leaders to meet pre-determined training objectives and training needs that emerge as a function of the current operating environment.

During one of our evaluations of a training game that contained sophisticated graphics, leaders rated the game on four aspects of realism:

- Physical realism *(Do Soldiers look like real Soldiers, does the terrain look realistic, do trees and vehicles look real?)*
- Psychological realism *(Were you immersed in your role as a leader during mission execution?)*
- Friendly force realism *(Does the friendly force react according to doctrine? Does it react in a timely manner?)*
- Enemy force realism *(Does the enemy force react as you would expect an enemy to react?)*.

Overall ratings were high on all four aspects, indicating how good the graphics were. However, leaders' ratings for the overall training value of the game did not parallel ratings for realism. These findings suggested that sophisticated graphics alone were not sufficient to have a marked impact on the way leaders perceived the game's overall training value.

During an evaluation of a relatively low-fidelity training game, leaders were told by their instructor that the game's software problems caused choppy movements among computer-generated entities. We expected ratings for overall training value to be low as a result of this. However, leaders' overall high ratings of the game, along with the majority of their written and verbal comments, suggested that they recognized the game's potential training value in spite of problems with fidelity because it allowed them to initiate critical tasks necessary for success during field training exercises. These findings, when combined with results from the evaluation discussed in the preceding paragraph, suggest that while sophisticated graphics can be used to improve a training game's level of perceived realism, they were neither necessary nor sufficient to make an impact on leaders' perceived training value.

We had other general impressions about the relationship of graphics and other game attributes to leader perceptions and behavior during the FSC and FSW evaluations. The FSC game required leaders to complete three phases: (a) plan a company command mission, (b) execute the mission, and (c) assess performance during an after action review that included a real-time replay of the mission. During the execution phase, the computer-generated friendly forces had a fairly lengthy approach toward the objective before they made contact with enemy forces. In contrast, training with FSW began with a brief summary of an operations order, followed by a computer-generated Infantry squad placed into the middle of a dangerous firefight in an urban environment.

By comparing what we observed during the two evaluations, we determined that leaders were slow to become immersed during FSC training, but their attention and involvement seemed to increase as threat levels and the complexity of their missions increased over time. We also noted that leaders seemed more intent on conducting follow-up missions on their own. The converse was true for FSW. Leaders seemed to be captivated immediately by the physical environment, the complexity and realism of the graphics, and the intensity of the scenarios. But as time passed, they seemed less engaged and less intent to conduct follow-up missions on their own.

From these observations, we concluded that higher-fidelity graphics served to focus leaders' attention initially, but were less important than other attributes for sustaining leaders' attention for longer periods of time. We also concluded that when combined with realistic graphics, the use of multiple phases, a game's ability to allow leaders to confront increasingly compelling conditions as they emerge over time, and the level of overall challenge can serve to maintain leaders' involvement across repeated mission executions.

During interviews, instructors at the Infantry School stated that graphics alone do not constitute an effective training tool. In addition, a game without sophisticated graphics technologies is perceived by leaders as more effective when a qualified human instructor is actively involved in the training process. If a trainer is directly involved during training games exercises, then lower levels of graphics resolution can be tolerated because it is the instructor, not the game, that determines the vision and focus of the training exercise.

An instructor can pinpoint the specific tasks for which the game was created to train based on the given level of fidelity, which is never perfect, and can help leaders focus on learning tasks instead of focusing on the graphics. For example, a leader who is focused on graphics fidelity might ask, "How much does this simulated tree look like a real tree?" An instructor can shift the leader's focus to ask a more tactically-appropriate question such as, "Does this simulated tree provide a realistic sense of cover and concealment?" If a human instructor can focus the attention of the training audience on what is important and what is to be trained, then the appropriately simulated aspects of a training game will be compelling, the expectations of leaders will be met, and the positive characteristics of the game can help drive leaders toward the ultimate purpose of the training.

Lesson #7: Training games should provide accurate representation of battle drills and tactics. More important to effective Infantry leader training than physical realism is the accurate representation of doctrine, tactics, and battle drills. Many of the leaders who participated in our training games evaluations were quick to assess the doctrinal and tactical accuracy of the training games. This was particularly the case with combat experienced squad leaders whose primary interests were battle drills and tactics, techniques, and procedures associated with urban operations.

There were instances during and following training exercises when leaders engaged in lively discussions about differences in tactics and standard operating procedures. There were also instances when leaders recognized and discussed tactical inconsistencies demonstrated by the games' computer-generated entities. Two common themes emerged during these discussions. Some leaders suggested that the few tactical errors they detected were distracting and probably impacted the way they rated the games with which they trained. Others stated that problems with tactics embedded in the games could be used as training opportunities when instructors pinpointed inaccuracies during after action reviews and then required leaders to discuss the necessary corrections and appropriate actions.

Regarding the tactical accuracy and fidelity of training games, data from our evaluations showed that leaders tended to be less critical of computer-generated enemy force actions and more critical of the behaviors of computer-generated friendly forces. During formal discussions on the topic of tactical fidelity, leaders said they wanted the same amount of control over the actions of friendly forces as they experienced in combat (e.g., ability to conduct more flexible and varied movements with friendly force entities, ability to assign better defense positions, and more control over room clearing exercises).

Common to all our evaluations were discussion comments directed at the way friendly troops sometimes responded to certain types of enemy contact. In these instances, leaders stated that friendly forces controlled by game software responded inappropriately, were too slow to respond, or did not respond at all. Leaders' comments also reflected the perceived value of reacting to asymmetric threats when computer-generated enemy forces represented them appropriately.

During discussions, leaders expressed concerns about the ability to conduct correct room clearing procedures with training games, particularly at the levels of fire team and individual rifleman. Leaders suggested that if training game scenarios included room clearing drills, then players needed control over the individual fire team members so that correct stacking, weapons orientation, and room entry could be demonstrated. If these capabilities were under the control of the game and not the player, then computer-generated entities needed to replicate appropriate battle drills and tactics in order for leaders to perceive that the training was an accurate representation of what would occur during field exercises or combat.

In defense of the use of training games with imperfect computer-generated entity behaviors, instructors we interviewed at the Infantry School stated that inaccuracies that exist in games should not be allowed to get in the way of the training that is supposed to occur. Because all training tools deviate from the ideal at some level, it is the responsibility of instructors to ensure that a game's inaccuracies are not used by leaders as an excuse not to learn. When tactical inconsistencies do emerge, they can be marginalized by instructors during scenario execution and addressed during after action reviews.

Do training games have to be fun?

Lesson #8: Learning and practicing leader skills with training games are more important than having fun. In our efforts to understand the role of fun and its impact on motivation for using training games, we presented questions to leaders during the RDT evaluations about the importance of learning combat skills, making rapid decisions, preparing for LFXs and field exercises, and fun and personal entertainment as reasons for wanting to train with the RDT. Results were consistent across separate evaluations of the squad and two platoon versions of the RDT. The majority of leaders gave high ratings to learning combat skills, making rapid decisions, and preparing for LFXs as important reasons for desiring to use the RDT as a training tool. Only a small minority of leaders believed that fun and personal entertainment were important reasons for training with the RDT. We believe these results indicate that, in general, leaders who are serious about using training games to maximize opportunities to learn leader tasks and skills and who may be close to entering combat as platoon leaders will place less emphasis on the element of fun that games can provide.

Developers of commercial games recognize that the success of their products is linked to the extent to which consumers perceive them as fun and entertaining. We do not know if fun improves the effectiveness of training games developed for dismounted light Infantry leaders. We believe that success for military training games is better measured by the level of cognitive and tactical challenge, how well they meet intended training objectives, and how well they help leaders learn and practice the skills that result in performance to standard.

How can training games maintain relevancy over time?

Lesson #9: The ability to modify training games beyond their prototype versions can ensure that they will continue to provide relevant training. Developing training games for dismounted light Infantry leaders is relatively new. So far, there has not been a sustained program of development that facilitates modifying existing games beyond their prototype versions. Initially, instructors may make time for using a new training game. However, if the game cannot be modified according to their experience, their changing training needs, or the emerging conditions of the current operational environment, then the game will not be utilized.

The ability to easily and quickly modify a training game ensures that it will remain relevant and that its future training potential can be realized. This means that training games developers and researchers will have to rely more on leader input and gain a better understanding of specific training needs during all phases of the development, evaluation, and modification processes. A best-case scenario of games modification will require qualified instructors and leaders to lend close scrutiny and provide consistent and frequent input throughout all stages of a training game program.

According to leaders and instructors we interviewed at the Infantry School, instructors who determine which methods to use in their courses can be faced with the dilemma of diminishing returns when training games cannot be modified from their prototype versions. As the constraints on time and other training resources grow tighter, instructors have to choose the best training payoff for the time invested. Without the ability to modify a game, instructors may perceive that it lacks sufficient training value or relevance and decide to replace it with other training methods appropriate to current needs and conditions.

If modifications can be made to training games relatively quickly and with little cost, then they can continue to meet the changing needs of leaders and instructors. It is certainly the case that leaders and instructors want effective and relevant training games, and they recognize the advantage of employing training games that are relatively easy to use and provide leaders with experiences that other existing methods cannot provide without significant investments of time and other resources.

Are training games more efficient than other existing methods of training?

Lesson #10: The efficiency and cost-effectiveness of training games compared to other methods of training remains unknown. As training budgets and resources have decreased, the Infantry School has made efforts to exploit the use of perceivably less resource intensive training tools and methods. These tools include PC-based virtual simulations and games that may augment or provide experiences similar to other, more costly and more time-consuming methods of field training. However, the extent to which training games provide cheaper, more efficient training than existing methods has yet to be determined.

Two measures of training effectiveness and efficiency are based on how well tasks and skills learned during training games exercises transfer to mission rehearsals and to exercises that take place in the field. Some instructors who have observed leaders during field exercises that followed training with games believe that the skills learned from games improved the decision-making and combat readiness of their leaders. Researchers have yet to support these conclusions empirically.

Another perceived benefit of training games is that they are generally cheaper to build and to use than other existing methods of training. This may be the case with simulations and games built for armor and mechanized Infantry units whose equipment is costly to build, operate, and maintain. However, the potential savings of using games for training dismounted Infantry leaders on cognitive leader skills remains unknown.

During discussions following squad leader level training game exercises, many leaders suggested that they were better served by learning squad battle drills and related tactics, techniques and procedures from field exercises, as opposed to learning them in the classroom with a training game. Because squad drills are relatively easy to set up and conduct in almost any field setting, leaders did not recognize any added

value or increase in the efficiency of using a training game to experience squad attack mission execution. In contrast, during platoon and company command level training game exercises, most of the leaders and instructors recognized that games offered them experiences with mission execution that would be costly and difficult to produce in the field because of the number of leaders required to replicate training exercises at these levels.

Lesson #11: Training games can allow leaders to rehearse cognitive tasks and skills in preparation for field exercises. Training games may save resources by helping leaders to be more prepared to learn from existing training exercises. This concept was best exemplified during our evaluations of the squad and platoon leader RDT.

As stated above, the RDT was developed to mirror the types of experiences and decision-making opportunities to which IOBC lieutenants are exposed during LFXs. Because live rounds are used during these exercises, the preparation for executing a safe and effective LFX must focus on safe leader behavior and the ability to repeat safe behavior. During LFXs, leaders are expected to concentrate simultaneously on safety and on conducting effective squad and platoon attack missions in an environment to which they have received only brief exposure. The RDT classroom training exercises gave leaders exposure to a simulation of the real environment in which the LFXs took place. It also exposed them to the critical tasks, tactical decisions, and behaviors that were required for safe and successful completion of squad and platoon attack missions.

Conclusions

Instructors at the Infantry school have provided leaders with new modes of training as advances in desk-top virtual simulations have emerged. One such advance has been the inclusion of commercial game technologies. Results from our evaluations suggest that, in general, instructors and leaders endorsed the use of training games at the Infantry School. As such, we have every reason to believe that Army leaders and instructors will continue to exploit games technologies to augment and improve existing leader skills training.

Sources of information from our evaluations included questionnaire ratings, interviews, formal and informal discussions, and observations. As yet, researchers have made very few experimental efforts to understand the direct effects of training games on the leaders who use them. Beyond results from our evaluations, little is known about the following:

- The extent to which training games can be effective stand-alone trainers
- The effect of sophisticated graphics on training game performance
- The effect of fun and entertainment on training game performance
- The extent to which skills learned and practiced during games training generalize to mission rehearsals and field exercises

- The extent to which games provide more efficient training over existing methods
- The extent to which training game performance and methods for assessing performance can be standardized

Until we begin to answer questions about the effectiveness of military training games empirically, the assumptions held and the claims made by both promoters and detractors will remain unsupported by reliable evidence.

While we suspect that training games have an important role to play in the preparation of leaders for current operating environments, we believe that refinements to training game software need to be guided by military SMEs who have a clear understanding of current and future training objectives. Those who are interested in using games to support the training of Infantry leaders have the opportunity to guide future efforts by providing experience and empirical support for effective methods of development and utilization as they become known.

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APPENDIX A

Description of the Janus Simulation

Janus is a two-sided (constructive), high resolution, interactive simulation of realistic battlefield events. The simulation is driven by a software system hosted on a mainframe computer. Janus has sufficient resolution to model individual fighting systems or individual Soldiers and can model realistically up to brigade-size forces. While originally developed to serve as an analytic tool during the design and development of materiel systems and force organizations, Janus can also be used as a training simulation and as a vehicle for assessing human performance. The interactive mode of operation used during human training and assessment applications allows military commanders and staff to practice the decision-making processes required to synchronize battlefield systems over successive phases of a mission. Janus displays digitized terrain data on computer monitor screens in a format familiar to military users. It models accurately a wide assortment of friendly and enemy force elements as a function of each fighting system's capabilities, as affected by factors such as terrain, weather, and visibility. Players of Janus must consider and synchronize all aspects force employment just as they would in actual combat. If they neglect key considerations, the simulation will highlight the planning failure during the battle. Conversely, Janus will reinforce positively a fully integrated and synchronized plan.